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1942

PRELIMINARY REPORT

on

COLOR VISION TESTING

Project V5-2

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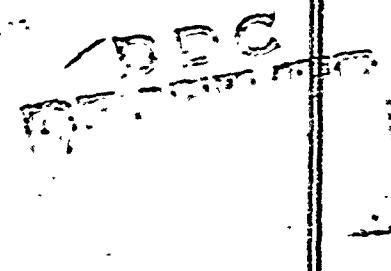
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COLOR VISION REPORT NO. 1

Medical Research Laboratory Report No. 7

September 12, 1942

Medical Research Division  
U.S.N. Submarine Base, New London, Conn.



## PRELIMINARY REPORT ON COLOR VISION TESTING

On June 11, 1942 project V5-2 was assigned to the Medical Research Division, Submarine Base, New London, Connecticut, by the Research Division of the Bureau of Medicine and Surgery, Washington, D.C. The description of the project, as contained in the assignment from the above Bureau, was: "Trial of Royal Canadian Navy Colour Vision Lantern in comparison with other color vision tests available at Submarine Base, New London. Project in exploratory stage under direction of Dr. Shilling. A problem under joint cognizance of Aviation and Submarine Sections of Research Division."

Pursuant to these instructions, research is being conducted using the following equipment:

- (1) The Pseudo-isochromatic plates manufactured by The American Optical Company,
- (2) The Royal Canadian Navy Colour Vision lantern,
- (3) The Farnsworth panel,
- (4) The Inter-Society Color Council Series 4-A "designed for testing color blindness",
- (5) The Edridge-Green Lamp,
- (6) The Vision Color Test Wools, and
- (7) The Jensen chart.

The subjects for this study are drawn from three sources: (1) the U.S. Navy men who are candidates for Submarine School reporting for physical examination, (2) the civilians who are candidates for enlistment in the Marine Corps and are having their preliminary examination at the Submarine Base Dispensary. (3) the civilians who are candidates for Civil Service appointments and are reporting for physical examination at the U.S. Naval Submarine Base Dispensary.

This group includes both men and women. The two latter groups are a good cross-section of the civilian population. On all groups we record not only the results of the tests, but also the individual's age, education, color of eyes, visual acuity, and the time required for the completion of the tests. On the submarine school candidates we record also the I.Q. (as measured by the Otis Self-Administering Test of Mental Ability), and any pertinent physical and neurological information.

The technical work on this project is being conducted by REED, John David, Ph.M.2c., who came to this activity from the Graduate School of Brown University. The tests are all conducted in the same Laboratory, and by the same technician, and in strict accordance with the instruction laid down by the manufacturers of the equipment.

#### FURTHER DESCRIPTION OF THE TESTS:

(1) The American Optical Company's Pseudo-Isochromatic plates are the present standard test for color vision in the Navy, therefore no detailed description is necessary. These plates resemble the Ishihara and Stillings plates formerly used by the U.S. Navy, which are no longer available because of the international situation. We have standardized the administration of the A.O. plates, using a distance of three feet and an illumination of 10-foot candles from a "daylight" lamp. Prompting, correcting, and other assistance sometimes adopted in the administration of this test, is avoided and the response is recorded without comment. The subject is allowed up to 20 seconds to consider each plate before responding. The instructions for reading the plates are merely, "Read the numbers down this page." With the plates containing lines which are to be traced, the examiner determines that the subject can or cannot see the line. The responses are recorded verbatim.

(2) The Royal Canadian Navy Colour Vision Lantern

presents nine combinations of pairs of red, green, and white light. All the filters are of polished Pyrex glass. The green filter is the standard signal green (Corning No. 440), the red filter is a deep red (Corning No. 241), and a colorless polished Pyrex (Corning No. 774) is used for the white. The lantern shows two horizontally disposed lights at a time. These are spaced 1" apart and a movable diaphragm permits the use of apertures which are either 0.2" or 0.02" in diameter. The larger apertures are used for demonstration and the smaller for test purposes. The individual tested is given one or more trials to identify the combinations correctly. The only deviation allowed is that the white light may be called "yellow", since the "white" has a distinctly yellow cast. These lights are designed to represent the running lights of a vessel of 25-foot beam at 2000 yards.

(3) The Farnsworth color panel was recently designed by Dr. Dean Farnsworth of New York University and consists of 35 color buttons which differ by equal amounts of color all through the spectrum. These buttons are set up in four long, narrow trays, with a fixed pilot button at either end of each tray. In each tray, color gradations with equal chromaticity differences are represented by twenty-odd identically constructed buttons. These buttons are to be arranged in proper order so as to make an even gradation of color from one pilot button to the other. The underside of each button is numbered so the test can be scored by turning the buttons over and observing whether or not they are in proper order. Graphic presentation is possible on a specially designed chart. (see Illustrations #9, #10, #11, #12)

The test is scored by noting the numerical differences between a button and the ones on either side of it. These two differences are then added and the sum is the score for that color button. For instance, if the order of a series is ---26, 28, 27---, then 28 is 2 units from 26 and one from 27 giving a total of 3 units. If the test is

correctly arranged the score is 2 units to every button.

(4) The Inter-Society Color Council has developed a special series of 15 chips designated as 4-A, "designed to test color blindness." These are to be arranged from pink to gray and thence to purple. The operator may place a standard color chip at either end and one in the middle and have the subject arrange the remaining chips to show the proper gradations of color; or the subject may be asked to match one set with another properly arranged set.

(5) The Edridge-Green lamp is another test for color blindness used routinely in the Navy as the final authority for determining officers' color vision. It consists of four wheels, ---three carry six colored glasses each (Red A and B, Yellow, Green, Signal Green, Blue and Purple), and one hole; and the fourth has a modifying lens, which may be one of the following: Ground glass, Ribbed glass, Neutral #1, Neutral #2, Neutral #3, Neutral #4, or Neutral #5. The three primary colors, plus signal green, blue and purple may be presented individually or in a great variety of combinations and in varying degrees of luminosity. The size of the aperture permitting egress of the light may be varied also.

(6) The Vision Color Test set of Wools, as available from the Naval Medical Supply Depot, is used in accordance with the accepted practice of matching these vari-colored yarns.

(7) The Jensen test is a chart on which is shown the faces of Four cloeks each showing colored hands in various positions. These are pseudo-isochromatic plates similar in principle to the American Optical Company's plates.

The American Optical Company's pseudo-isochromatic plates are at present the most widely used test for color perception in the U.S. Navy. We had expected to use these plates as a standard for comparison with the Royal Canadian Navy Colour Vision test.

However, we found the American Optical Company's plates to be so indefinite and confusing and the responses of known color-normal individuals were so variable and lacking in decision as to necessitate an exhaustive study of these plates. This paper is principally a presentation of the results of this phase of the study.

RESULTS:

In reading the A-O plates, the majority of the 438 individuals included in this study (who actually had normal color vision), made an inordinate number of errors in calling the plates. Illustration No. 1 shows, in graphic form, that less than 6% had a perfect score, whereas the average number of mistakes per person was 5.1, and the greatest number of errors was 19. No individual was included in this part of the study who was considered to be color-weak or color-blind (i.e. no one was included who made any significant errors in the "confusion plates").

Individuals who were rechecked for any reason are not included in the above class. The rechecks fall into three groups: (1) Those who upon re-examination with the entire battery of tests were passed as normal, or somewhat color-weak; (2) Those who failed the Royal Canadian Navy Colour Vision Lantern, but were accepted for submarine duty -- often because of previous naval experience rendering them of sufficient value to the Service to compensate for this defect; and (3) those whose color perception was so sub-normal as to necessitate rejection for the submarine service. On the basis of our color tests, the subjects classified in Groups 2 and 3 should not have been enlisted in the U.S. Navy.

Illustration No. 2 is a tabulation of these three groups of rechecked individuals. These are subjects who gave an equivocal performance and were considered to be of sufficient interest to retest them on the other tests in our group. It will be noted here

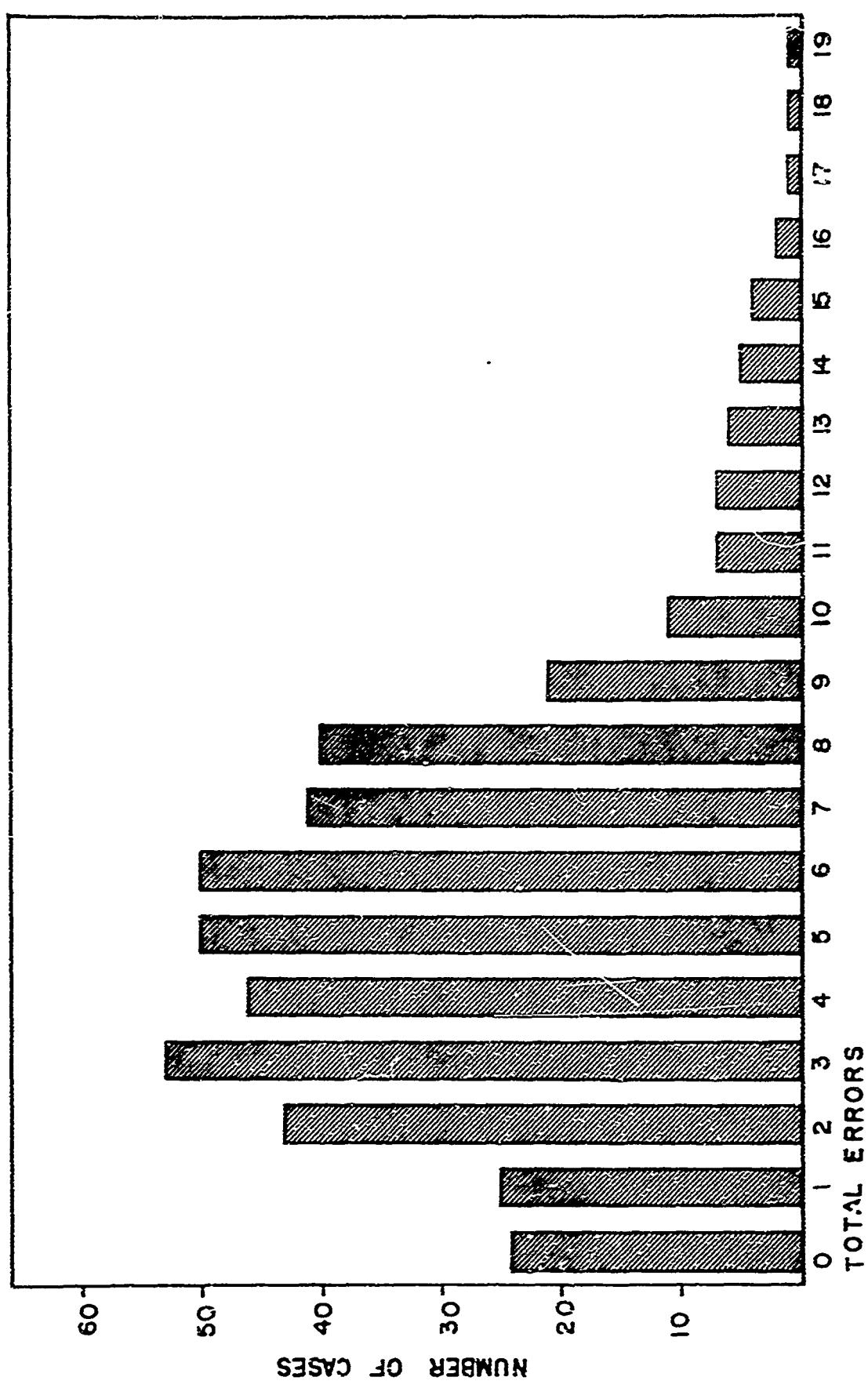


ILLUSTRATION NO. 2

The following table presents the total number of errors on the American Optical Company's plates made by those individuals who were rechecked: --

Number of Errors	GROUP #1 Retested Normal or color-weak	GROUP #2 Failed R.C.N. Lantern	GROUP #3 Re- jected: Color-blind
5	1		
6	2		
9	4		
10	1		
11	1		
15	2		
18	1		
20	1		
21	1	2	
23	1	1	
25		1	1
26	2		
29		1	
30		1	1
31			2
34			1
35	1		
36			1

that the scatter is in a different area, -- the least number of errors was 5, the average number of errors was 20.5, and the greatest number was 36.

Illustration No. 3 presents in tabular form all of the errors made by our 438 "normal" subjects on each of the A.O. plates, - for example, for Plate #7 the correct answer is 39; however, 275 of the 438 subjects miscalled this plate, as follows: 267 individuals called the figure 89, five called it 80, one called it 98, one called it 33, and one called it 30. No errors were made on plates #25, #26 or #46, which are designed to test malingering. It is significant that no errors were made on plates #15, 16 and #5, #6 or #41, which are confusion plates designed to detect red-green color blindness. There were no errors on Plate #35 or #36, both of which show lines easily followed by the person of normal vision, but rarely by the red-green blind individual. This tabulation confirms the fact that the individuals included in this part of the study were normal, insofar as color perception is concerned.

Illustration No. 4 is a graphic presentation of the material recorded on Illustration No. 3, and is designed to present a comprehensive picture at a glance. The ordinate is the number of errors and the abscissa is the plate number and shows the correct response. In each column we have grouped the incorrect responses given and have labelled them if they total five or more. For example, for Plate #30 the normal response should be 75, whereas seventy individuals called the number 25, fifteen called the number 76, ten individuals called it 85, nine people did not know what the number was, eight called it 26, and the rest gave various other responses which are grouped together in the uncolored section of the column.

Illustration No. 5 shows the interpretation of the Pseudo-Isochromatic plates for testing color perception, as it is given in the Manual furnished by the American Optical Company. This is an

ILLUSTRATION NO. 3

The following table is an analysis of all of the errors made on each A-O plate by 438 subjects.

Plate #	Cor. Resp.	Total Errors	Breakdown of errors according to numbers miscalled and by how many.						
*1	89	3	80	88	98	(That is, one person called it 80, one 88, and one 98)			
			1	1	1				
*2	43	196	89 193	68 2	18 1				
*3	56	4	66 4						
*4	27	35	22 22	28 5	29 4	87 1	2? 1	23 1	25 1
5	8	0							
6	3	0							
*7	39	275	89 267	80 5	98 1	33 1	30 1		
*8	42	22	48 9	62 4	22 3	12 2	47 1	52 1	82 1
*9	56	2	58 2						
*10	27	30	22 14	29 12	28 3	20 1			
11	29	118	20 111	28 3	79 2	70 1	26 1		
12	57	26	37 25	35 1					
*13	86	1	88 1						
*14	75	63	76 34	85 11	25 9	26 4	95 2	96 1	73 1
15	7	0							
16	9	0							
*17	25	8	26 4	85 3	25 1				
*18	68	7	88 5	45 1	63 1				

\*See Illustration No.7 for a further analysis of the errors on this plate.

ILLUSTRATION NO. 3

(continued)

Plate #	Coz. Resp.	Total Errors	Breakdown of errors according to numbers miscalled and by how many subjects.											
			1	2	3	4	5	6	7	8	9	10	11	12
19		5	4	8	2									
				3	1									
20		3	6	5	8									
				4	2									
*21		97	12	87	98	96	92	27						
				6	3	1	1	1						
*22		34	73	84	85	35	64	80	54	35	33	83		
				59	7	5	2	1	1	1	1	1		
*23		96	5	66	86	63	46							
				2	1	1	1							
24		27	58	22	28	29	88	97	87	99	29			
				30	13	9	2	1	1	1	1			
25		12	0											
26	H	C												
*27		89	10	88	29	?	82	8?						
				4	2	2	1	1						
*28		43	190	48	68	63	98	47	23	28	?	?		
				178	6	1	1	1	1	1	1	1		
*29		85	18	88	95	46	36	26	85	?	1			
				8	4	2	1	1	1	1				
*30		75	122	25	76	85	?	26	95	75	88	63	23	62
				70	15	10	9	8	2	2	2	2	1	1
*31		52	43	62	58	32	59	82	68					
				28	7	2	2	2	2					
*32		96	2	86	98									
				1	1									
33	--	144		45	25	35	43	47	65	47	34	46		
				124	4	4	3	3	3	2	1	1		
34	--	143		73	75	23	25	29	27	78	28	72	79	76
				61	33	21	12	6	3	2	2	1	1	1
35	line	0												
36	line	0												

\*See illustration No. 7 for a further analysis of the errors on this plate

ILLUSTRATION NO. 3

(continued)

Plate	Cor.	Total	Breakdown of errors according to numbers mis-called and by how many subjects.											
#	Resp.	Errors												
*37	052	17	062	952	292	252	055	852	032					
			10	2	1	1	1	1	1					
*38	394	199	894	895	295	227	884	233	804	895	395	594		
			184	5	3	1	1	1	1	1	1	1		
39	23	223	28	25	?	83	83	29	93	26	2?	93	93	
			175	10	10	8	5	4	4	2	2	1	1	
40	65	98	?	68	66	05	63	69	65	85	6?	88	89	75
			25	21	20	14	5	2	2	1	1	1	1	03 64
41	15	0												
42	74	6	24	71										
			4	2										
43	47	60	43	42	46	?	40	27	49	87	67	57	17	
			13	13	12	8	5	3	2	1	1	1	1	
44	93	73	?	95	93	68	88	08	92	?	94	9?	95	83
			14	11	10	9	8	6	3	3	2	2	1	1
45	--	49	line											
46	line	0	49											

\* See Illustration No. 7 for a further analysis of the errors on this plate.

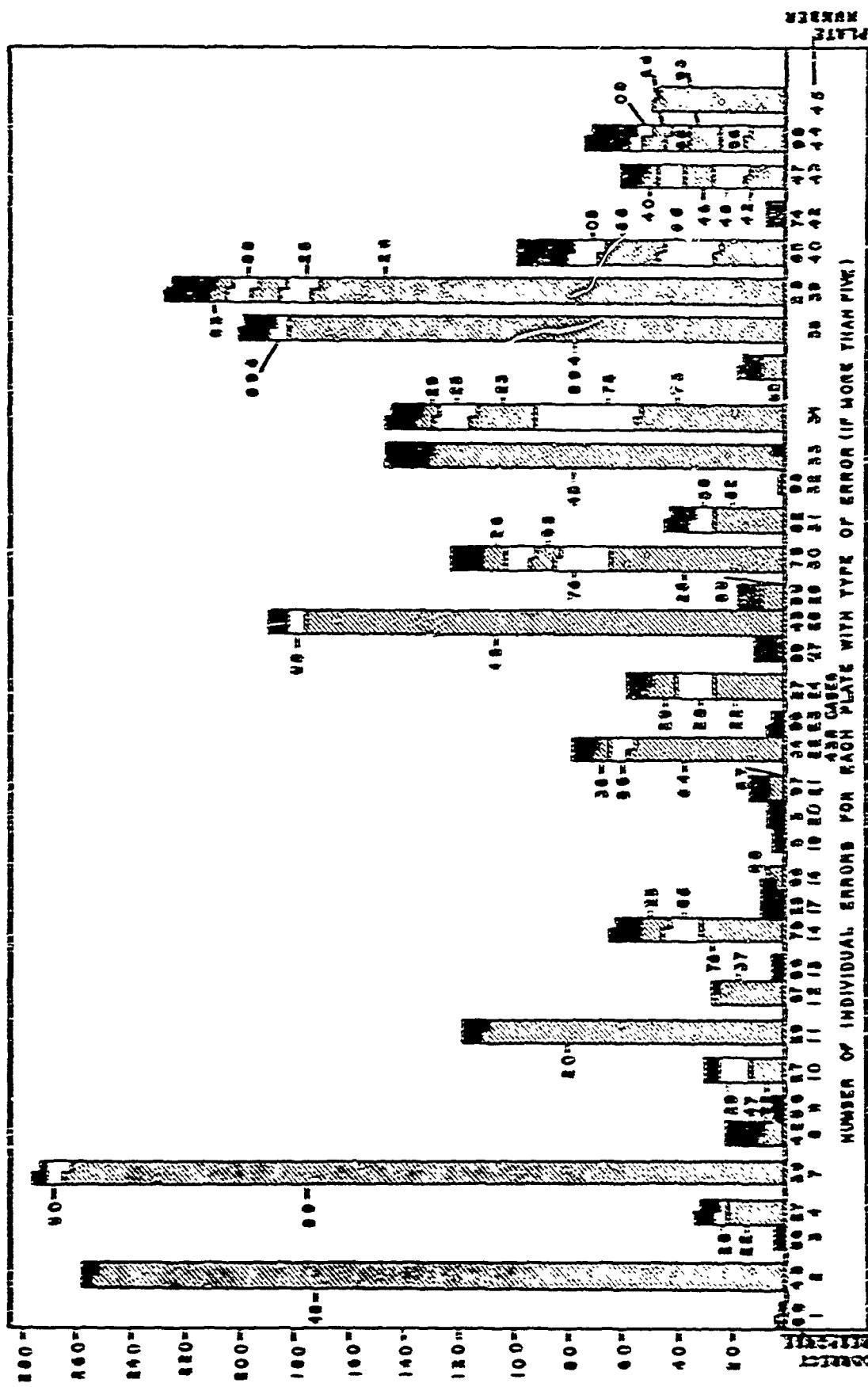


ILLUSTRATION NO. 5

INTERPRETATION OF PSEUDO-ISOCHROMATIC  
PLATES,  
as given in the manual furnished by the American  
Optical Company.

PLATE NO.	NORMAL PERSON READS	RED-GREEN BLIND READS
1	89	Rarely
2	43	Rarely
3	56	Rarely
4	27	Rarely
5	8	3
6	6	5
7	39	Rarely
8	42	Rarely
9	56	Rarely
10	27	Rarely
11	29	70
12	57	35
13	86	Rarely
14	75	Rarely
15	7	Rarely
16	9	Rarely
17	25	Rarely
18	68	Rarely
19	5	2
20	3	5
21	97	Rarely
22	34	Rarely
23	36	Rarely
24	27	Rarely
25	12	12
26	H	H
27	89	Rarely
28	43	Rarely
29	86	Rarely
30	75	Rarely
31	52	Confusion Nos.
32	96	Confusion Nos.
33	Rarely	45
34	Rarely	73
35	Follows Line	Rarely
36	Follows Line	Rarely
37	052	Confusion Nos.
38	394	Confusion Nos.
39	23	Rarely
40	65	Rarely
41	15	17
42	74	21
43	47	Rarely
44	98	Rarely
45	Rarely Follows Line	Easily Follows Line
46	Easily Follows Line	Easily Follows Line
	*****	

exact copy of the table in the manual and is given simply as a ready reference.

Illustration No. 6 is self-explanatory and is given for purposes of comparison with our results.

Certain plates in Illustration No. 3 are marked with an asterisk and the digits on these plates are subjected to further analysis in Illustration No. 7. These are the plates in which the formation of the digits is unusual, for example, the seven appears thus, ; the two, so -- and the three, so -- . In this table the total possible errors are calculated by multiplying the number of times the digit appears by the 200 individuals reading the same, -- thus the number two appears eight times and multiplying this by 200 equals 1600 possible errors.

The unequal occurrence of these total possible errors has been adjusted to a percentage basis and is presented in Illustration No. 6. Thus three is called eight 502 times out of a possible 1200 times, or 41.8% of the times, etc. It is noteworthy that three is called eight because of the close resemblance between the type of three presented in the various plates and a typical eight. Errors of this nature certainly cannot be considered due to defective color perception. It is much more likely that they are due to the atypical formation of the figures on the plates. All confusion factors in a color vision test should be confined to the color element and every effort should be made to control other factors, such as intelligence, previous experience, etc.

Our work so far indicates that the use of the American Optical Company's Test for Color Perception (strictly interpreted and given without assistance) designates as color-blind a far greater percentage of individuals than actually have this deficiency. It is perfectly possible to materially raise the performance by coaching.

ILLUSTRATION NO. 6

Revision of Scoring on American Optical Company's Color Vision Test

----

Proposal sent to Captain J.C. Adams, (MC) U.S.N. by Lt. Comdr. J.G. Jenkins, A-V(S), U.S.N.R.

----

1. Data reaching the Bureau of Medicine and Surgery indicates that some Selection Boards are rejecting an unduly large percentage of applicants because of failure to meet standards on the subject test of color vision.
2. It is believed that this results from unwarranted rigidity in scoring responses to the individual plates.
3. A research project conducted with a large population shows that all of the following responses should be scored as correct.

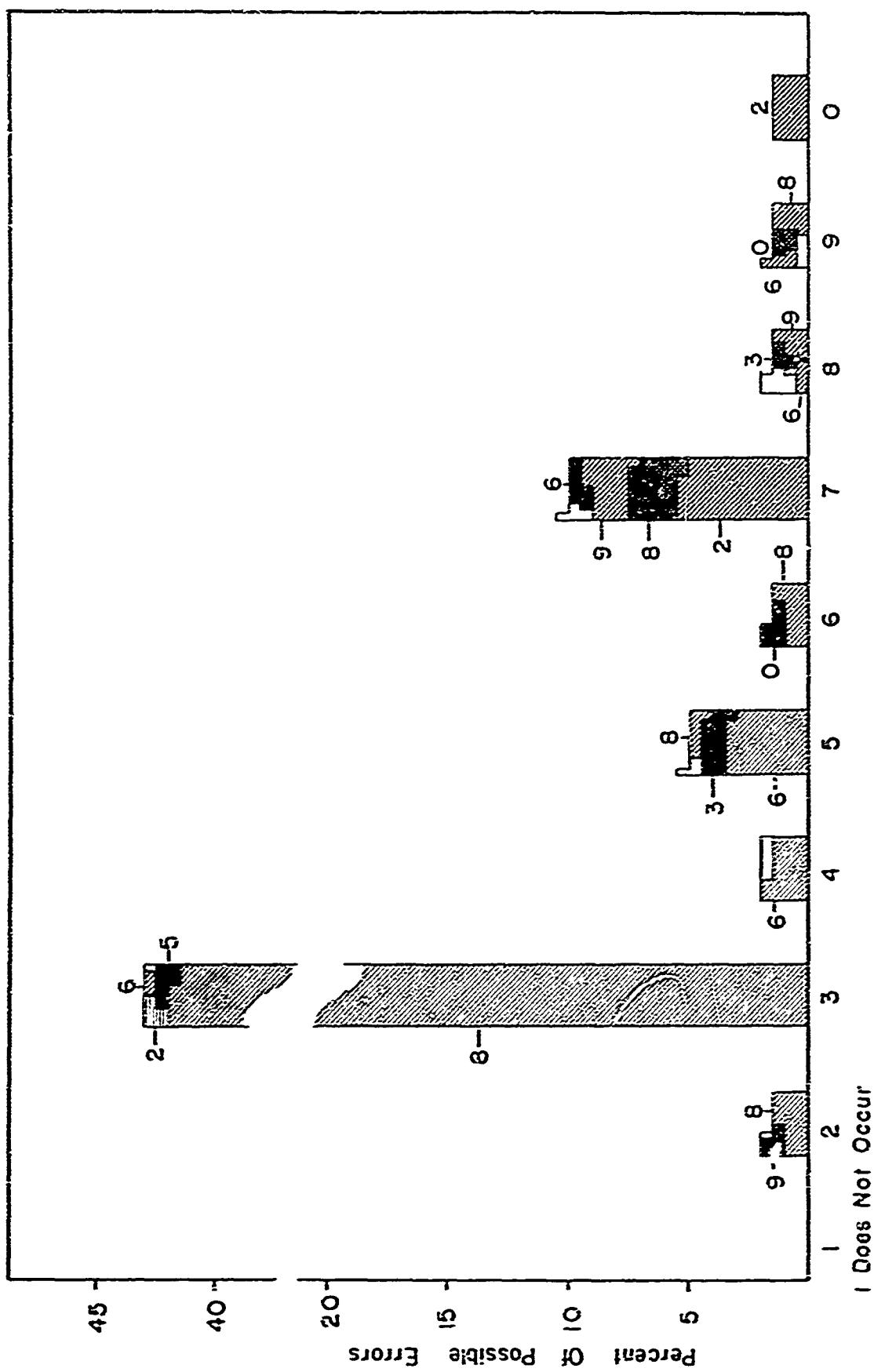
PLATE	ACCEPTABLE RESPONSES
2	43, 48
7	39, 89
11	29, 20
12	57, 37
14	75, 76
22	34, 84
28	43, 48
30	75, 25
33	No number, 45
34	No number, 73
38	394, 894
39	23, 28
40	65, 66

ILLUSTRATION NO. 7

The following table is an analysis of the number of errors made in calling the various digits on all plates in the A.O. test, except the confusion, line, and malingering plates.

200 cases

Digit	Total Possible Errors	Total Errors	Breakdown according to Erroneous Response
1	0	0	
2	1600	27	8 (20) 9 (5) 6 (1) 7 (1)
3	1200	516	8 (502) 5 (6) 2 (4) 6 (3) 9 (1)
4	1200	24	6 (14) 2 (3) 1 (2) 3 (2) 5 (2) 8 (1)
5	1800	92	6 (62) 8 (18) 3 (8) 9 (3) 4 (1)
6	1600	27	8 (18) 9 (9)
7	1400	142	2 (75) 8 (29) 9 (26) 6 (7) 0 (2) 1 (1) 5 (1)
8	1200	26	3 (9) 6 (5) 2 (5) 4 (3) 9 (2) 5 (1)
9	1400	22	8 (9) 0 (5) 6 (4) 2 (2) 3 (2)
0	200	3	2 (3)



This is the usual custom in administering this test in the Navy, that is, when an individual miscalls a plate, the operator asks him to read it again, or says "Are you sure?" or "Read that again, please." Of course, the alert subject will realize he has made a mistake and make another try, even if he guesses. Any test allowing or requiring such coaching for its proper performance is obviously unsatisfactory because of the variability of the assistance given. Great leniency in interpreting these plates has been allowed in the Jenkins proposal (see Illustration No. 6), but even this is not sufficient to eliminate the difficulties and confusion. For example, for Plate #40 the color normal response is supposed to be 65. The Jenkins proposal (Illustration No. 6) allows either 65 or 66. We find that among those individuals making errors on this plate, the most prevalent type of error is that of seeing no number at all, while a significant group give other answers (68, 05, etc.). We feel that if one incorrect response is permissible, any of these incorrect responses could conceivably be allowed with the same justification.

The Jenkins proposal allows for the miscalling of Plate #12, but does not allow for the miscalling of Plate #45. In our series twenty-five errors were made on Plate #12, and forty-nine were made on Plate #45. To be consistent, the miscalling of Plate #45 should certainly be allowed as normal.

Plate #34 is another example in point. According to the American Optical Company manual (Illustration No. 5) the normal individual "rarely" reads this plate, whereas the red-green blind ordinarily reads 73. If one allows as normal both no number or 73 (as set up in the Jenkins proposal), then we feel the plate is diagnostically valueless. In addition to the response allowed by Jenkins, there are a great number of people who called this plate 75, 23, 25, 28, and various other numbers. Is a person to be failed on this plate because he is insufficiently "color-blind", with the result that he calls the plate 75 instead of the normal red-green blind response of 23? If 73 is allowed, then any response must be considered correct

and the plate contributes only confusion.

On the basis of this study we recommend:

(1) the substitution of a more satisfactory test for color perception;

or (2) an entire revision of the plates, simplifying the figures and the formation of some of the digits;

or, at least (3) the deletion of the unsatisfactory plates.

In this report, we are not giving an extensive account of any of the other tests, but will briefly mention some of the results. We have included as Illustrations No. 9, No. 10, No. 11, and No. 12 actual score sheets on representative cases on the various tests. An explanatory paragraph accompanies each illustration.

**The Royal Canadian Navy Colour Vision Lantern:** In our investigation of this equipment, we have tested both those who are normal and those whose color perception is defective on our other tests. The subjects being tested are given the following instructions: "Name the colors from left to right. These are simple, pure colors and should be named accordingly, that is, say red -- not maroon, or rose, or pink, etc." The subjects are not told that there are only three colors and that these are red, green and white.

As yet we have tested an insufficient number to justify any final conclusions as to the accuracy of this lamp in determining color-blindness. However, we can state that we consider the instructions accompanying the equipment seem to be inadequate, as no allowance has been made for the following specific inaccuracies often encountered with the lantern when we are testing color-normal subjects:

the green light (signal green) is sometimes called "blue",  
the white light is often called "yellow", sometimes called  
"orange" or "amber"

The manual accompanying the lantern allows the white to be called yellow, but makes no allowance for any other alternative. Actually, the "white" light does have a distinctly "yellow" cast. Obviously, the value of the lantern would be enhanced by a revision of the instructions to make allowance for these often-encountered inaccuracies. Except for this element of confusion, the lantern has been satisfactory as an indicator of abnormal red-green color perception. A further report on our results will be made at a later date.

Illustration No. 12 presents a case whose performance on the other tests is poor, but is perfect on the Royal Canadian Navy Colour Vision Lantern, since his anomaly is in the blue-yellow axis.

The Farnsworth test has the distinct advantage of giving a qualitative and a quantitative score, permitting statistical analysis, and an individual presentation in graphic form. The records for the four representative cases mentioned above demonstrate this feature. We are actually using this test as a means of measuring how good the other tests are.

We have no comment to make at this time concerning the other tests. A further report will be made at a later date.

ILLUSTRATION NO. 9

J.W., Civil Service candidate:

This man made most of his errors in the blue and yellow region and thus he is anomalous in the red-green, (for example, the errors in the yellow are due to his inability to distinguish various amounts of red). This is confirmed by his performance on the Royal Canadian Navy lantern in which he miscalled green, red, and white; and by his inability to read the digits on most of the plates of the American Optical Company's test. His I.S.C.C. performance is inaccurate, also.

Population

Date: 9-3-42

Name: J. W. \_\_\_\_\_ Date or Rank: \_\_\_\_\_  
(Last Name) First Middle

Age: 32 Color of Eyes: Blue Length of Service: - - -

Visual acuity: 20/20 Education: 6 I.Q.: - - -

Notes on Eyes: \_\_\_\_\_ Time: \_\_\_\_\_

PSEUDO-ISOCERATRIC PLATES:

PLATE #	1	2	3	4	5	6	7	8	9	10	11	12	12	14	15	16	17
Normal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2 - G	-	-	-	-	-	-	-	-	-	70	-	-	-	-	-	-	-

PLATE #	18	19	20	21	22	23	24	25	25	27	28	29	30	31	32	
Normal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2 - G	-	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-

PLATE #	33	34	35	36	37	38	39	40	41	42	43	44	45	46	
Normal	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X
2 - G			No	No	-50	94	-	-	-	-	-	-	-	-	-

ROYAL CANADIAN COLOR LANTERN TEST

Actual	Comb. No.	Subject Response	Actual	Comb. No.	Subj. Response
GR	1	GG	GB	8	GG
CG	2	✓	GR	8	✓
IG	3	✓	WG	9	YG
RR	4	RR	WG	9	YR
RR	4	PG	Repeat:		
RG	5	RG			
RG	6	RG			
RR	7	✓			

Name - W.H. CIVIL SERVICE LABORER Age 32 -

Date 9. 13. 1942

25	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	30	31	32	33	34
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76

2 1/2 minutes

20..... 24.....

20  
21  
22  
23

MONCHEN CO. INC.  
for Color Values

Designed by  
MONCHEN CO. INC.  
10 East Franklin Street  
Baltimore, Md.

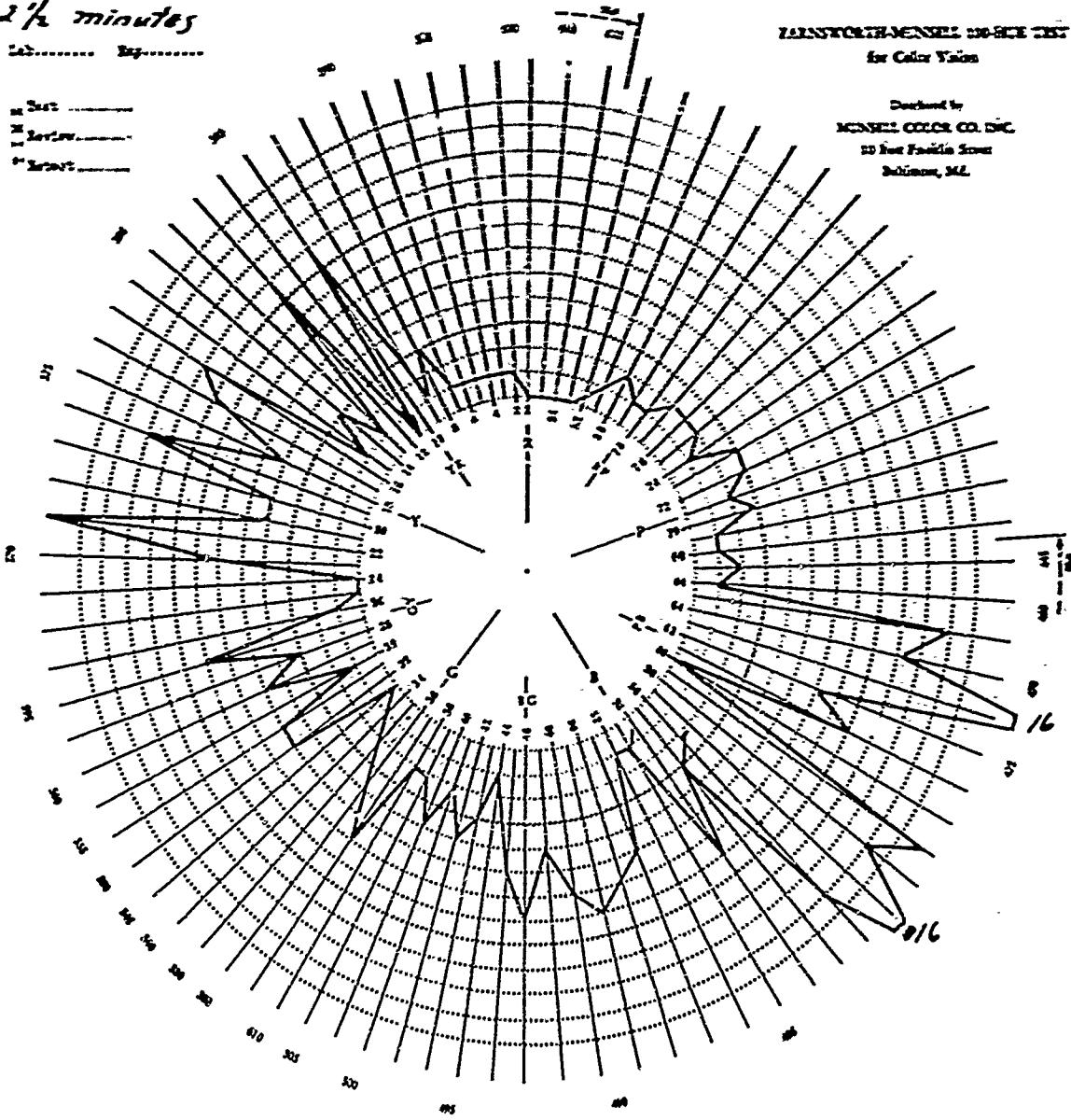


ILLUSTRATION NO. 10

W.J.F., A.S.:

This case is that of an individual who identifies the green of the Royal Canadian Navy Colour Vision Lantern as "blue". His ten errors on the American Optical Company plates are not significant and his Farnsworth performance is fair. On the I.S.C.C. he made two errors of transposition.

Recheck

Date: 8-6-72

Name: W.J.F. Date or Rank: A.S.  
(Last Name) (First)

Age: 20 Color of Eyes: Blue Length of Service: 1 1/2

Visual acuity: 20/20 Education: 12 I.Q.: 116

Total on Eyes: \_\_\_\_\_ Name: \_\_\_\_\_

SECOND-ISOCHROMATIC PLATES:

PLATE #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Normal	✓	✓	✓	✓	✓	✓	X	✓	✓	✓	X	✓	✓	✓	✓	✓	✓
R - G							39				20						25

PLATE #	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Normal	✓	✓	✓	✓	✓	X	✓	✓	✓	✓	X	✓	✓	X	✓	✓
R - G						58					48		76	59		

PLATE #	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Normal	✓	✓	✓	fol.	fol.	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	folios
R - G						374	—	—				—	—			

FINAL CANADIAN COLOR LUMPH TEST

Actual	Comb. No.	Subject Response	Actual	Comb. No.	Subj. Response
GR	1	BY	GR	8	BR
GG	2	GB	GR	6	BR
RR	3	RB	RG	9	YB
RR	4	✓	RG	9	YB
RR	5	Yw	Repeat:		
RR	6	✓			
RR	7	✓			

Time H. J. RS.

Aug 29.

Date 8/16/52

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	8010	8011	8012	8013	8014	8015	8016	8017	8018	8019	8020	8021	8022	8023	8024	8025	8026	8027	8028	8029	8030	8031	8032	8033	8034	8035	8036	8037	8038	8039	8040	8041	8042	8043	8044	8045	8046	8047	8048	8049	8050	8051	8052	8053	8054	8055	8056	8057	8058	8059	8060	8061	8062	8063	8064	8065	8066	8067	8068	8069	8070	8071	8072	8073	8074	8075	8076	8077	8078	8079	8080	8081	8082	8083	8084	8085	8086	8087	8088	8089	8090	8091	8092	8093	8094	8095	8096	8097	8098	8099	80100	80101	80102	80103	80104	80105	80106	80107	80108	80109	80110	80111	80112	80113	80114	80115	80116	80117	80118	80119	80120	80121	80122	80123	80124	80125	80126	80127	80128	80129	80130	80131	80132	80133	80134	80135	80136	80137	80138	80139	80140	80141	80142	80143	80144	80145	80146	80147	80148	80149	80150	80151	80152	80153	80154	80155	80156	80157	80158	80159	80160	80161	80162	80163	80164	80165	80166	80167	80168	80169	80170	80171	80172	80173	80174	80175	80176	80177	80178	80179	80180	80181	80182	80183	80184	80185	80186	80187	80188	80189	80190	80191	80192	80193	80194	80195	80196	80197	80198	80199	80200	80201	80202	80203	80204	80205	80206	80207	80208	80209	80210	80211	80212	80213	80214	80215	80216	80217	80218	80219	80220	80221	80222	80223	80224	80225	80226	80227	80228	80229	80230	80231	80232	80233	80234	80235	80236	80237	80238	80239	80240	80241	80242	80243	80244	80245	80246	80247	80248	80249	80250	80251	80252	80253	80254	80255	80256	80257	80258	80259	80260	80261	80262	80263	80264	80265	80266	80267	80268	80269	80270	80271	80272	80273	80274	80275	80276	80277	80278	80279	80280	80281	80282	80283	80284	80285	80286	80287	80288	80289	80290	80291	80292	80293	80294	80295	80296	80297	80298	80299	80300	80301	80302	80303	80304	80305	80306	80307	80308	80309	80310	80311	80312	80313	80314	80315	80316	80317	80318	80319	80320	80321	80322	80323	80324	80325	80326	80327	80328	80329	80330	80331	80332	80333	80334	80335	80336	80337	80338	80339	80340	80341	80342	80343	80344	80345	80346	80347	80348	80349	80350	80351	80352	80353	80354	80355	80356	80357	80358	80359	80360	80361	80362	80363	80364	80365	80366	80367	80368	80369	80370	80371	80372	80373	80374	80375	80376	80377	80378	80379	80380	80381	80382	80383	80384	80385	80386	80387	80388	80389	80390	80391	80392	80393	80394	80395	80396	8039

ILLUSTRATION NO. 11

R.E.G., E.M.3c:

This case is chosen as being normal on all tests except for the A-C plates. His Farnsworth performance is fair (a few errors are made by nearly everyone) and he made no errors on the R.C.N. lantern. On the I.S.C.C. test he made one error of transposition, which is not significant. His A-O performance is not good, as he miscalled twenty-six plates.

## Routine Recheck

Date: 8-31-42

NAME:	G	R	E.	Rate or Rank:	EM 3/4
(Last name)		First	Middle		

AGE: 19	Color of Eyes: Brown	Length of Service: 6 mo.
Visual acuity: 20/20	Education: 12 yrs.	I.Q.: 89 D
Notes on Eyes:		Time: 3 min 10 sec

## PSYCHO-ISOCHROMATIC PLATES:

PLATE #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Normal	X	Y	X	X	Y	Y	X	Y	X	X	X	X	Y	X	Y	Y	X
B - G	80	68	99		89	68	97	75				76					26

PLATE #	1	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Normal	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
B - G	8	5	36		77											

PLATE #	33	34	35	36	37	38	39	40	41	42	43	44	45	46	
Normal	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	Follow
B - G				252					17	71					Line

## ROYAL CANADIAN COLOR LAMPRE TEST

Actual	Comb. No.	Subject Response	Actual	Comb. No.	Subj. Response	
GG	1	/	GG	3	/	
GG	2	/	GG	8	/	
GG	3	/	GG	9	/	
RR	4	/	RR	9	/	
RR	4	/	Repeat:			
RR	5	/				
RR	6	/				
RR	7	/				

Name R. E. G. EM % 230.17 Date 9.11.42

25	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42			
43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62			
23	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	70	71	72	73	74	

2 minutes

Date Sept. 11, 1942

FARNSWORTH-MUNSILL 200-HUE TEST  
for Color Vision

Developed by  
MUNSILL COLOR CO., INC.  
10 East Franklin Street  
Baltimore, Md.

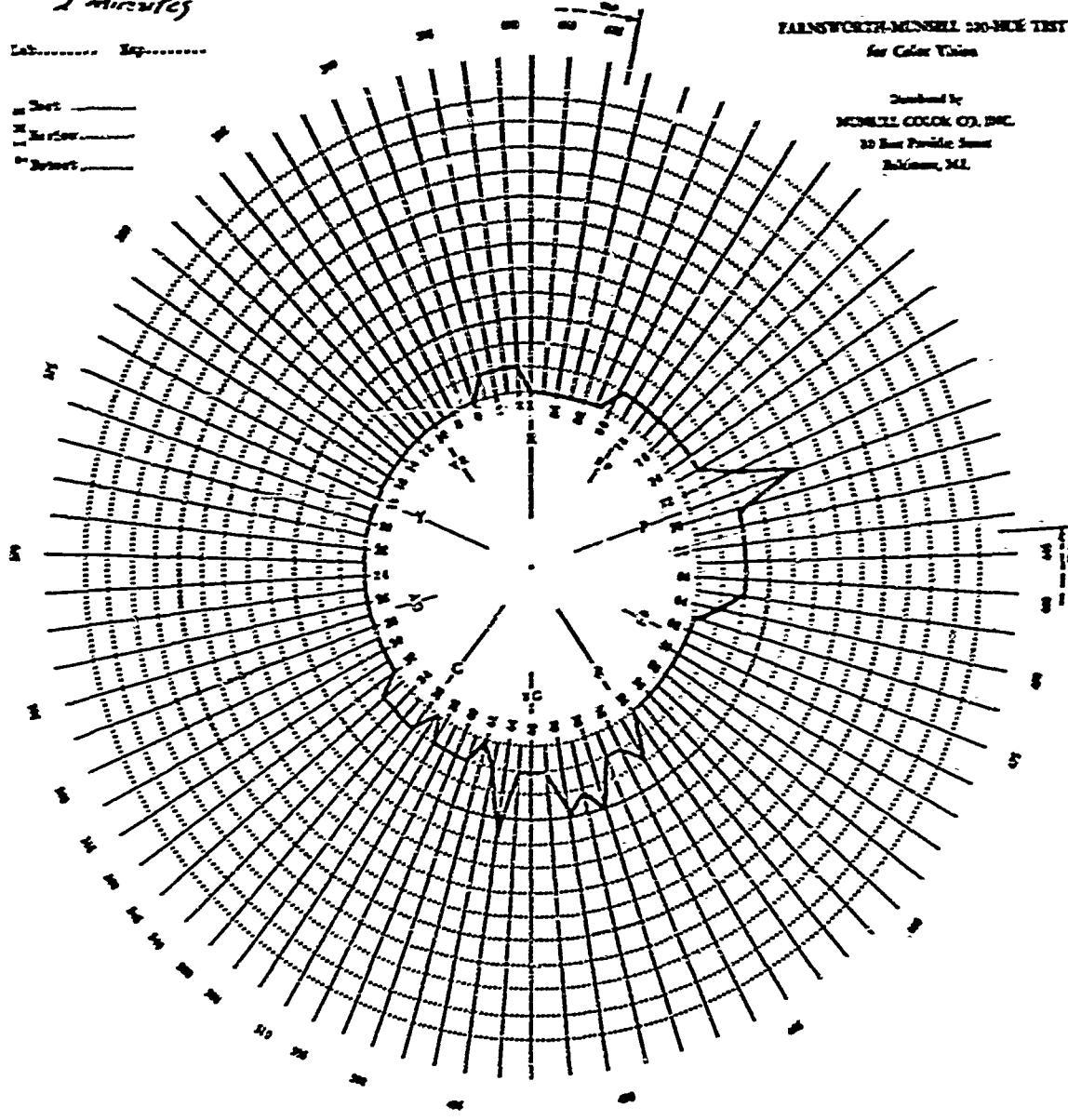


ILLUSTRATION NO. 12

E.L.I., Sea, 2c.:

This man was found to be blue-yellow blind by the Farnsworth Panel. One could not diagnose his deficiency correctly from his poor A-O performance. He made mistakes on many other plates besides those designed to catch this type of anomaly. He made no errors on the Royal Canadian Navy lantern. This man shows that the Royal Canadian Navy lantern does not screen the blue-yellow anomalous.

Recheck

Date: 7-27-42

NAME: E. L. T. Date or Rank: S 3/c  
(Last name) First Middle

SB: 17 Color of Eyes: Gray Length of Service: 5 yrs

Visual acuity: 20/20 Education: 10 I.Q.: 104 A

Notes on Eyes: Time:

PSEUDO-ISOCHEMATIC PLATES:

PLATE #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Normal	83	43	56	27	8	6	39	42	56	27	29	57	85	75	7	9	25
R - G		48			5	89	-	76	-	-	-	-	-	-			

PLATE #	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
Normal	68	5	5	97	34	56	27	12	H	29	43	86	75	52	96	
R - G	69	2	5		54	-	28			-	-	-	-			

PLATE #	33	34	35	36	37	38	39	40	41	42	43	44	45	46	
Normal	-	--	fol	fol.	052	394	23	65	15	74	47	98	-	follows	
R - G		29	No	No		894	-	-	17	21	-	-			

ROYAL CANADIAN COLOR LANTERN TEST

Actual	Comb. No.	Subject Response	Actual	Comb. No.	Subj. Response
CG	1	/	GR	8	/
GG	2	/	GR	8	/
RG	3	/	WG	9	/
WR	4	/	WG	9	/
RR	4	/	Repeat:		
WW	5	/			
RW	6	/			
RR	7	/			

Name L. L. L. Sex Male age 17 Date 7/31/42

85	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	30	31	32	33	34	35
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83

2 minutes

Lab..... Exp.....

PARNSWORTH-MUNSELL 100-HUE TEST  
for Color Vision

Described by  
MUNSELL COLOR CO. INC.  
10 East Franklin Street  
Baltimore, Md.

